

Earth Science Data Systems Software Reuse Working Group 2006 Year-end Report

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Activities during 2006 included recommendations to NASA HQ to encourage and enable software reuse; completion of a trade study; formalization of requirements and use cases, an architecture study, and initial development of prototype reuse enablement systems; continued development of a web-based portal; and discussion of bottom-up reuse topics. These efforts are related to one another, and their success has been due in part to our interactions with other working groups through joint meetings. Throughout the year, we have held monthly telecons and weekly support group telecons.

Recommendations to and Response from Headquarters. We recommended that NASA develop standard language for use in future procurement and grant notices that will encourage more software reuse, establish a web-based information portal for the sharing and dissemination of information about software reuse practices for the Earth science community, and establish a Reuse Enablement System (RES) to facilitate cataloging and distribution of reusable assets for the Earth science community.

HQ has accepted policy language recommendations and is currently implementing them, e.g., in the ROSES (Earth science) announcements. HQ encourages the continued development of the Software Reuse (<http://softwarereuse.nasa.gov>) web site. HQ is in the process of reviewing the results of our RES Trade Study and preparing a written response, but verbal approval/agreement has been obtained.

Trade Study. At HQ's request, we conducted a trade study of existing software catalogs and repositories. We concluded that none of the existing sites fulfill the role of a software repository for the Earth science community, and none of the systems provide the capabilities needed to function as a reuse enablement system. Therefore, we feel that a new catalog/repository system is needed to encourage and better enable software reuse within the community of Earth science software developers. Some collaboration with existing systems may be possible, but existing systems alone cannot meet the needs of this community. The results of our trade study have been presented to HQ, and we are awaiting a formal response. We have received verbal agreement with our results and, therefore, have continued to work in this area.

Formalization of Requirements and Use Cases, Architecture Study, and Initial Development of Prototype RES. The Reuse Working Group previously developed a set of use cases for the proposed RES. These were used to develop the initial requirements for the RES as presented in our trade study. In 2006, we formalized both the use cases and the requirements. With our earlier work documented, we began to work on an architecture study, examining existing software and systems that can provide the base catalog/repository for the RES. We created two

prototype sites, using XOOPS and Savane, for evaluation purposes. Evaluation will be based on our formalized requirements and will be done with prototype sites and examination of live, production sites. For example, we talked with the developers of the GSFC Source Motel site to help us evaluate GForge.

Portal Web Site. We designed, developed, and now maintain a website (<http://softwarereuse.nasa.gov>) for providing news and information on reusable assets, links to various catalogs (e.g., GCMD, Ames and GSFC Open Source), links to funding opportunities, and dates and contact information for upcoming events relevant to software reuse. Statistics have shown increases in the number of unique, new, and repeat visitors, as well as increases in the number of visits and page views over the past year. November 2006 was our most popular month at the time of writing with 980 visits and over 3,000 page views from 843 unique visitors, almost 90% of them being new. The site has also achieved high ranks in web search results for the term “software reuse,” to date reaching as high as first on MSN and Live.com, first on Yahoo, and second on Google.

Software Reuse Literature Review. The Software Reuse WG identified categories of content for services and resources to be made accessible to the public on the Software Reuse Portal. An interface also was established to facilitate submissions of recommendations for resources to be included on the portal web site. Members of the WG nominated selected references for articles to be cited on the portal web site as external resources relevant to software reuse. The WG developed a procedure for independently reviewing each nominated article, by at least three WG members, for potential inclusion on the Software Reuse Portal as recommended resources. The WG established the criteria for evaluating the nominated articles and a review form was created, based on the article evaluation criteria, to capture each reviewer’s evaluation and recommendation. Approximately 14 WG members volunteered to review articles nominated for inclusion on the portal, selected articles to review, and reviewed the nominated articles, providing recommendations for including exceptional articles on the Software Reuse Portal. Article reviews completed during 2006 resulted in recommendations for two articles to be referenced on the Software Reuse Portal and for one article not to be referenced on the portal. The two recommended articles have been included as references on the Software Reuse Portal, approximately eight articles are continuing to be reviewed by Software Reuse WG members, and an additional six articles are awaiting review.

Other Resources. We also developed and now maintain a collaboration web site and a WG mailing list.

Collaboration Web Site: <http://teambps.mywsssite.com/seeds/wg/reuse/default.aspx>

Mailing List: http://majordomo.gsfc.nasa.gov/cgi-bin/majordomo/info/software_reuse (web site is Goddard-only access)

Bottom-up Reuse. At the 5th Joint ESDSWG Meeting, we researched, presented, and discussed various topics in software reuse as viewed from the perspective of an individual developer. Presentations not covered during the meeting were presented during the December monthly telecon. This is the beginning of work that will continue into next year, and will provide individuals with more guidelines on reuse.

Publications and Presentations during 2006:

- Wolfe, R. "NASA Earth Science Data Systems (ESDS) Software Reuse Working Group", presentation at Navy's Open Architecture Workshop (February 2006, Washington, DC)
- Downs, R.R. "Meeting Challenges for Creating a Long-Term Archive for Socioeconomic Data: A Case Study" presentation at Fedora User's Group Conference (June 2006, Charlottesville, VA)
- Gerard, R., Delnore, V., Wolfe, R. "Reuse Portal Popularity" handout presented at ESIP Conference (July 2006, Palisades, NY)
- Marshall, J.J., Gerard, R., Samadi, S., Wolfe, R.E. "A Study of Earth Science Software Reuse Enablement Systems", Geoscience and Remote Sensing Symposium, 2006. IGARSS '06. Proceedings. 2006 IEEE International, vol.6, no.pp. 2832-2835. Poster presented at IGARSS 2006. (August 2006, Denver, CO)
- Marshall, J.J., Olding, S.W., Wolfe, R.E., Delnore, V.E. "Software Reuse Within the Earth Science Community", Geoscience and Remote Sensing Symposium, 2006. IGARSS '06. Proceedings. 2006 IEEE International, vol.6, no.pp. 2880-2883. Poster presented at IGARSS 2006. (August 2006, Denver, CO)
- Wolfe, R. "NASA Earth Science Data Systems (ESDS) Software Reuse Working Group", presentation at CEOS WGISS 22 (September 2006, Annapolis, MD)
- Gerard, R., Denore, V., Marshall, J., Wolfe, R. "Software Reuse Portal Web Site" poster presented at 5th ESDS WG Meeting (November 2006, College Park, MD)
- Gerard, R., Downs, R., Marshall, J., Wolfe, R. "Reuse of the Software Reuse Portal" poster presented at 5th ESDS WG Meeting (November 2006, College Park, MD)
- Castalia, B. "Feeding the Goose to Get Golden Eggs: Institutional Support and Legal Obstacles to Open Source Software" presentation at 5th ESDS WG Meeting (November 2006, College Park, MD)
- Downs, R.R., Delnore, V.E. "Intellectual Property Rights Issues for Software Reuse" presentation at 5th ESDS WG Meeting (November 2006, College Park, MD)
- Swick, R. "(Re)use of Virtual Globes for the Earth Sciences" presentation at 5th ESDS WG Meeting (November 2006, College Park, MD)
- Sherman, M. "Hierarchy of Reuse – Designing Systems to Promote Reuse" presentation at 5th ESDS WG Meeting (November 2006, College Park, MD)
- Wilmot, J., Bartholomew, M.O. "A Core Plug and Play Architecture for Component-Based Reusable Flight Software Systems" presentation at 5th ESDS WG Meeting (November 2006, College Park, MD)
- Gerard, R., Downs, R.R., Marshall, J.J., Wolfe, R.E. The Software Reuse Portal: A Case Study in Packaging Software to Contribute to Reuse Practices, poster presented at AGU 2006 Fall Meeting (December 2006, San Francisco, CA)
- Marshall, J. "Bottom-up Software Reuse: Documentation" presentation at Working Group telecon (December 2006)
- Gerard, R. "Object Oriented Programming and Its Relevance to Software Reuse" presentation at Working Group telecon (December 2006)
- Hunter, M., Bertolli, A. "Metadata and Its Relevance to Software Reuse" presentation at Working Group telecon (December 2006)
- Samadi, S., Gerard, R., Hunter, M., Marshall, J.J., Schweiss, R.J., Wolfe, R.E., Masuoka, E.J. "Reusing Software to Build Data Processing Systems: NPP Science Data Segment Case

Study”, Aerospace, 2007, IEEE Conference, submitted. To be presented at the 2007 IEEE Aerospace Conference (March 2007, Big Sky, MT)

2007 Tasks for Enablement and Policy.

- *Reuse Enablement System:* Complete and submit architecture study, develop implementation plan, develop and test prototype.
- *Reuse Portal:* Provide more content and keep up-to-date, promote portal to community, develop approaches for bottom-up reuse, enhance discovery of reusable assets.
- *Provide Incentives for Reuse:* Recognize examples of reuse, work on recommendation/justification for HQ to develop a funding opportunity to make assets/components reusable.
- *Metrics/Measurement:* Continue to generate/analyze statistics for portal web site, assess efforts required to package assets for reuse.
- *Promote Reuse:* Continue publications in journals and presentations at conferences, prototype a process for facilitating reuse through mentoring, develop a reuse readiness level scale.
- *Policy:* Continue working with Office of Technology Transfer to facilitate software release process.
- *Reuse of Services:* Identify potential to promote reuse of web services.

2007 WG Partnerships. Focus on areas of cooperation and collaboration with other WGs, use the Technology Infusion WG capability vision/roadmap as a framework, engage Interoperable Information (Web) Services, help with metadata definition, identify reusable assets for categories of web services components, HDF product content standards, and identify reusable assets for implementing a possible standard.

2007 Outreach and Education Strategy: We plan to identify outreach and education activities for each audience segment, explore communication opportunities for each activity and audience, prioritize activities to optimize capabilities and interests of team, and develop and identify resources to foster reuse awareness and understanding. Further, we plan to submit articles to Earth science journals, magazines, and bulletins; post Reuse WG announcements on list servers and newsletters; establish community collaboration forums for sharing reuse experiences; and utilize the portal to disseminate outreach and education resources on reuse.

2007 Challenges: We recognize the need to increase the level of participation in our WG, to identify and reach out to decision makers at NASA Centers, to reach out to other Earth Science domains, and to obtain legal and business advocates for release of software for reuse.

Table 1 – Contributing Working Group Members

Member Name	Affiliation	NASA-Funded Project	NASA-Funded Project PI
Angelo Bertolli	Innovim / NASA GSFC	ESDS Software Reuse Working Group Support Team	

Howard Burrows	Autonomous Undersea Systems Institute (AUSI) / National Science Digital Library (NSDL)	ESIP Federation	
Nancy Casey	SSAI / NASA GSFC	REASoN – Ocean Color Time-Series Project	Watson Gregg
Victor E. Delnore	NASA LRC	REASoN – Synergistic Data Support of Atmospheric Chemistry Field Campaigns / Chemical Digital Atlas	Victor Delnore
Robert R. Downs	Columbia University Center for International Earth Science Information Network (CIESIN)	Socioeconomic Data and Applications Center (SEDAC)	
Yonsook Enloe	SGT Inc. / NASA GSFC	ACCESS – The Development and Deployment of a CEOP Satellite Data Server	Kenneth McDonald
Stefan Falke	Washington University in St. Louis	REASoN – Services for Helping the Air-quality community use ESE Data (SHAirED)	Stefan Falke and Rudolf Husar
Ryan Gerard	Innovim / NASA GSFC	ESDS Software Reuse Working Group Support Team	
Mary Hunter	Innovim / NASA GSFC	ESDS Software Reuse Working Group Support Team	
Tommy Jasmin	University of Wisconsin Space Science and Engineering Center	REASoN – Satellite Observations in Science Education (SOSE)	Steven Ackerman
James J. Marshall	Innovim / NASA GSFC	ESDS Software Reuse Working Group Support Team	
Shahin Samadi	Innovim / NASA GSFC	ESDS Software Reuse Working Group Support Team	

Mark Sherman	SGT Inc. / NASA GSFC	ACCESS – High Spatial and Temporal Resolution Continental Water Mass Anomaly Fields from GRACE: Improving Accessibility for Hydrological Research and Applications	David Rowlands
Ross Swick	National Snow and Ice Data Center	Distributed Active Archive Center	
Bill Teng	SSAI / NASA GSFC	REASoN – Integrating NASA ESE Data into Global Agricultural Decision Support Systems	Steven Kempler
Robert E. Wolfe	NASA GSFC	ACCESS – Improving Access to Land and Atmosphere Science Products from Earth Observing Satellites: Helping NACP Investigators Better Utilize MODIS Data Products	Jeffrey Morissette

Table 2 – Additional Working Group Members

Member Name	Affiliation	NASA-Funded Project	NASA-Funded Project PI
Nadine Alameh	MobiLaps / NASA GSFC	Geosciences Interoperability Office	
Bradford Castalia	University of Arizona	High Resolution Imaging Science Experiment (HiRISE)	Alfred McEwen
Mike Folk	National Center for Supercomputing Applications (NCSA)	HDF Support for EOSDIS	
Emily Greene	Raytheon / NASA GSFC	Microwave Limb Sounder	
Stephen Olding	Everware-CBDI / NASA JPL	ESDS Technology Infusion Working Group	
Frederick Watson	California State University Monterey Bay	REASoN – Systems Integration & Visualization of Yellowstone (SIVY)	Frederick Watson